Langley Chemical Mechanism for the Global Modeling Initiative

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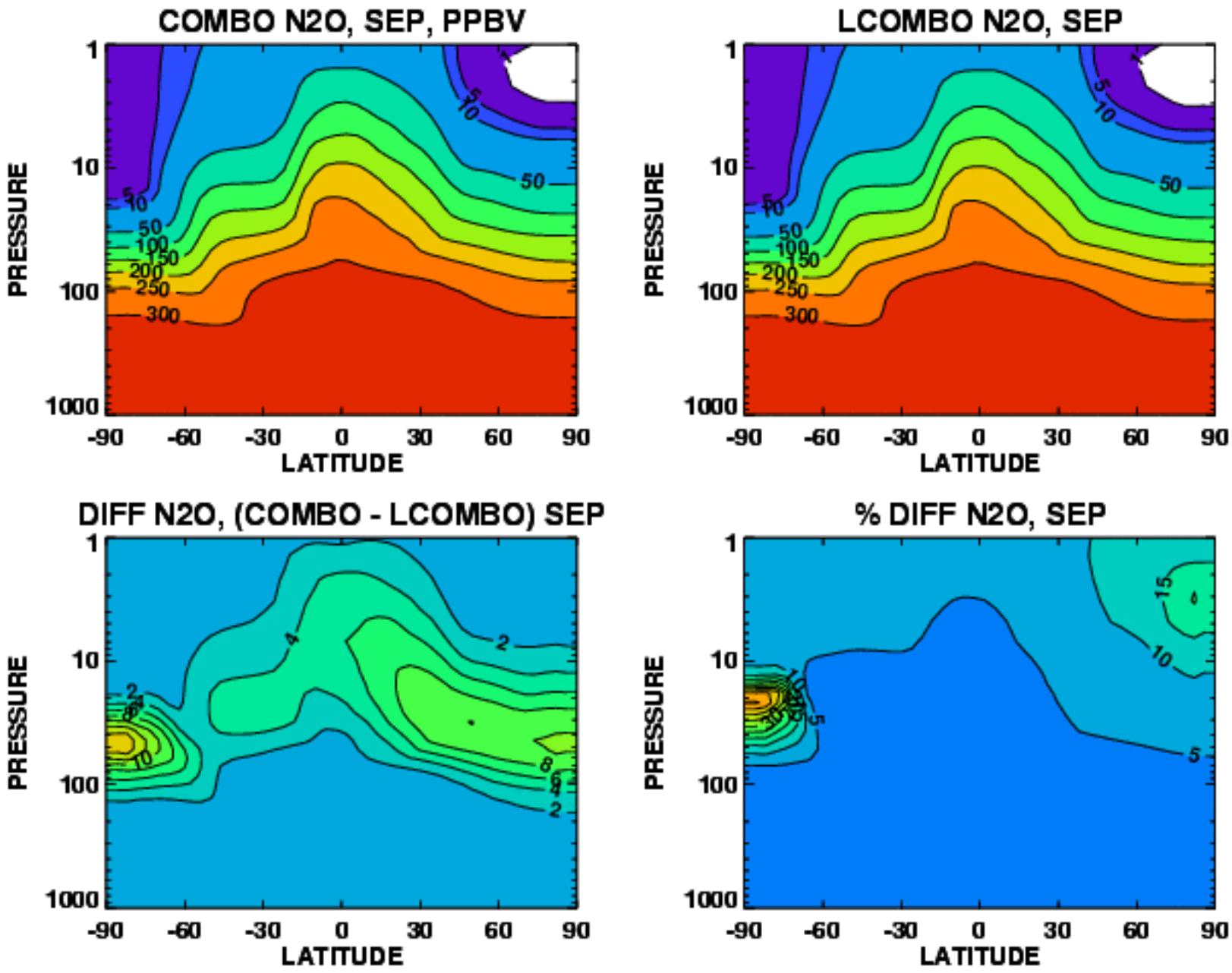
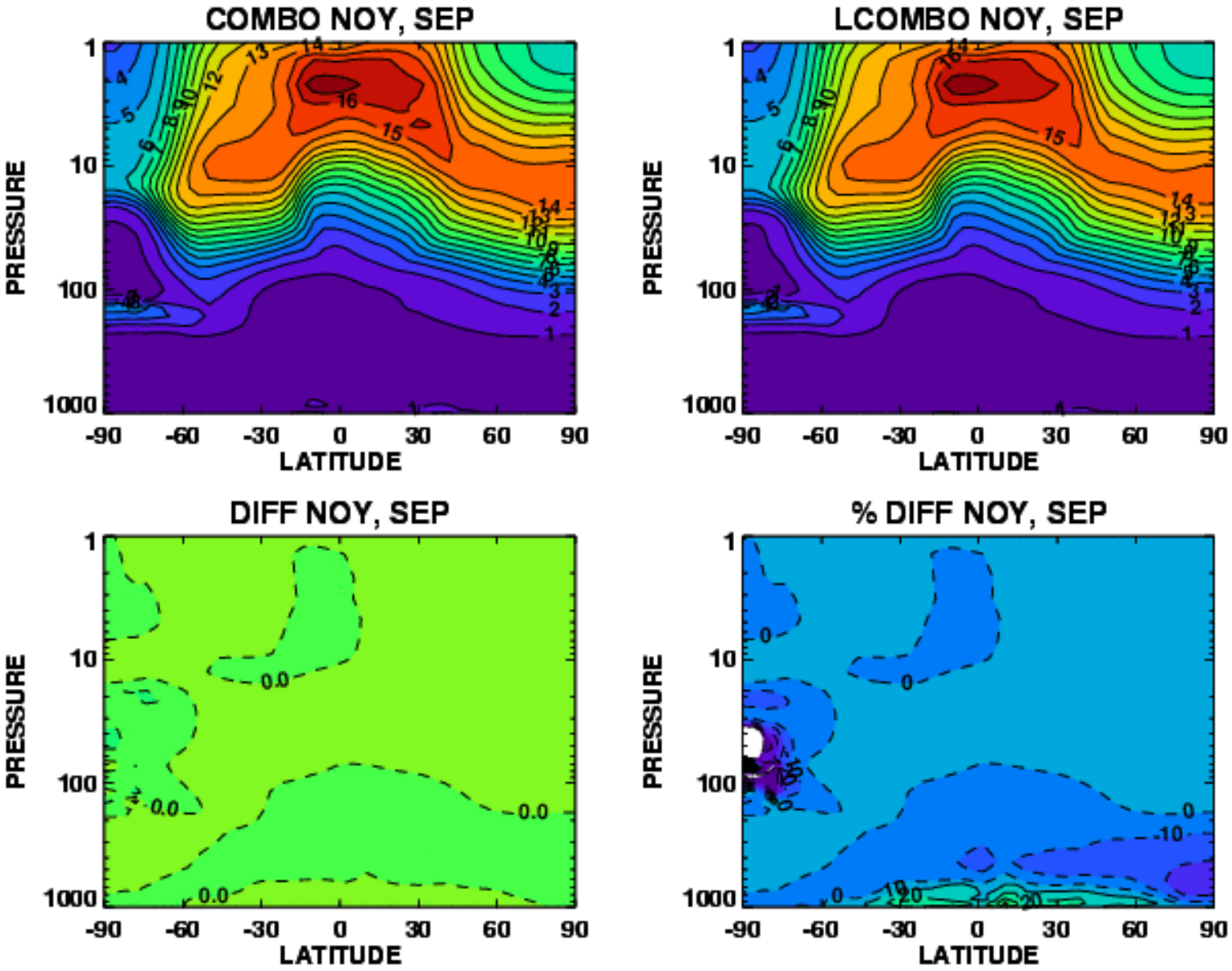
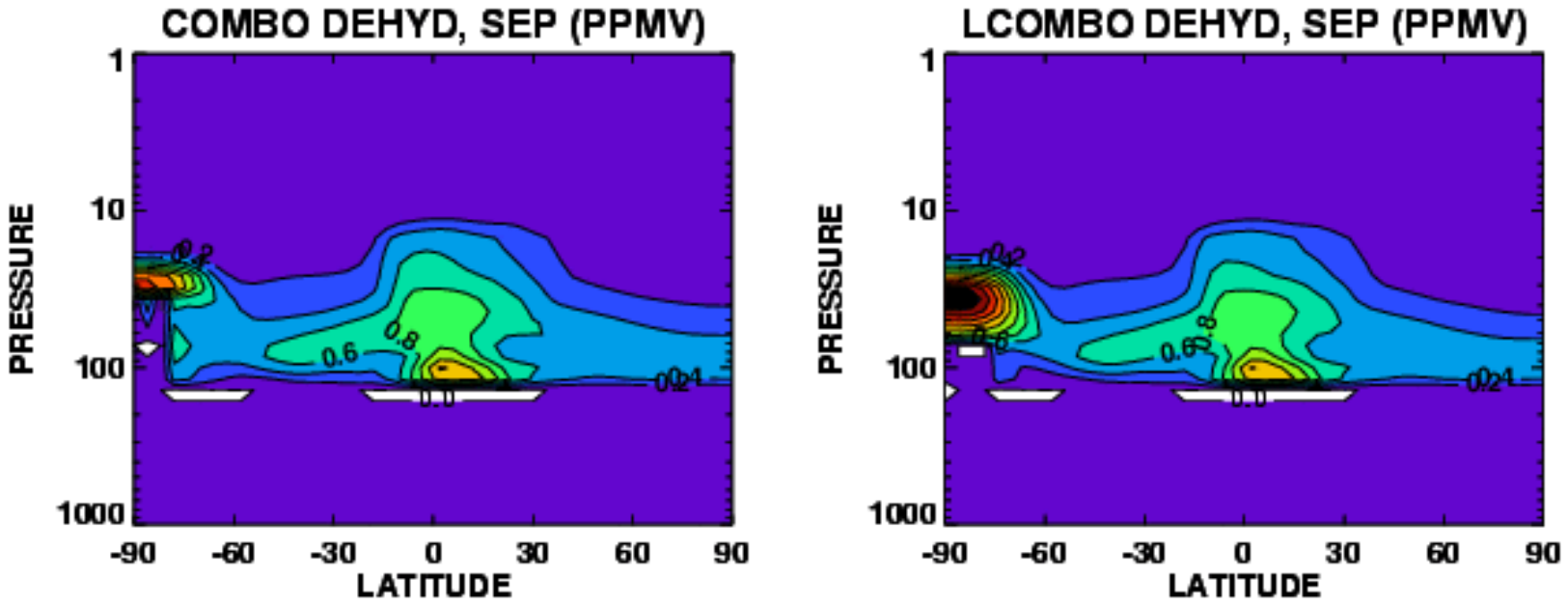
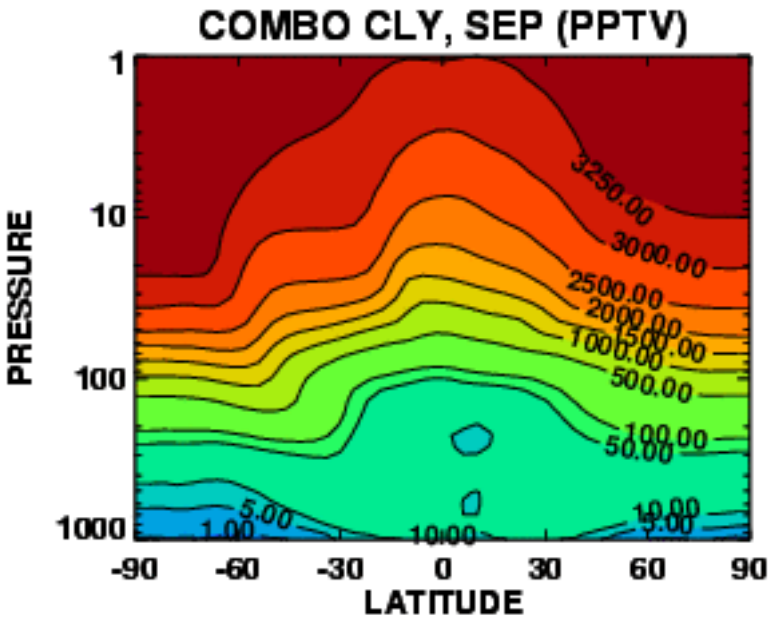
Progress during last 6 months

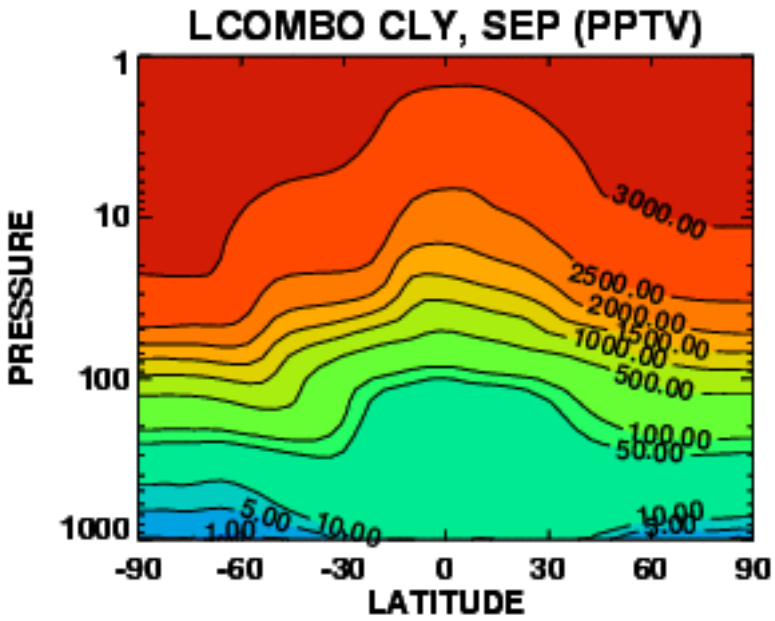
- Problem in LaRC isoprene oxidation mechanism identified:
  - Peroxides from isoprene oxidation lumped in with peroxides from NMHC oxidation caused problems for >C3 alkane species.
  - Fix developed and tested in box model with GEAR solver:
    - Add 4 new peroxide species from isoprene scheme & treat separately
  - Testing underway to identify efficient solution for LaRC fast solver.
    - Desire to keep mechanism efficient and not add many new species.
    - Attempts to partition not successful to date.
- Fix implemented and tested in LaRC mechanism for GMI model (raises number of species by 4).
- Updated LaRC mechanism implemented in GMI v2, with SMVGEAR II.
  - Two-year runs using 1994 fvgcm winds integrated
  - Currently comparing runs with LaRC and standard chemical mechanisms.

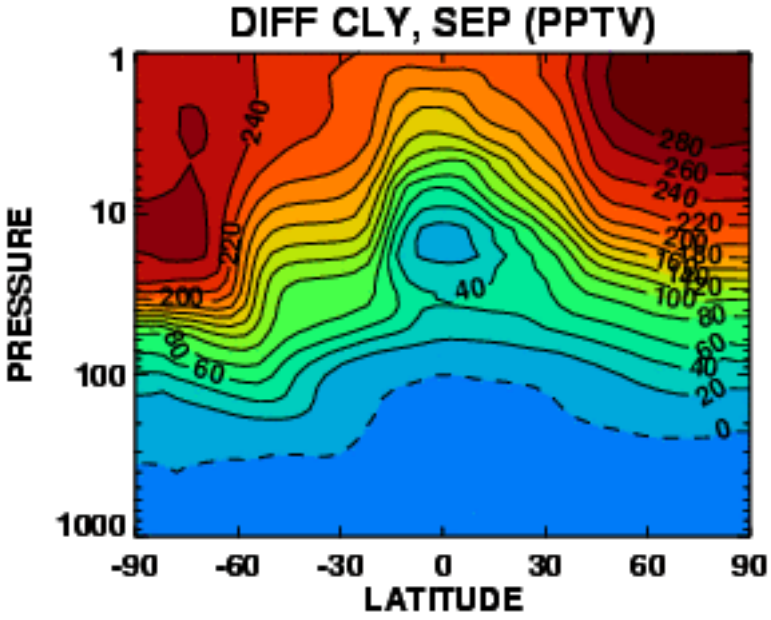

COMBO N2O, SEP, PPBV
LCOMBO N2O, SEP
DIFF N2O, (COMBO - LCOMBO) SEP
% DIFF N2O, SEP
PRESSURE
LATITUDE
1
10
100
1000
-90
-60
-30
0
30
60
90

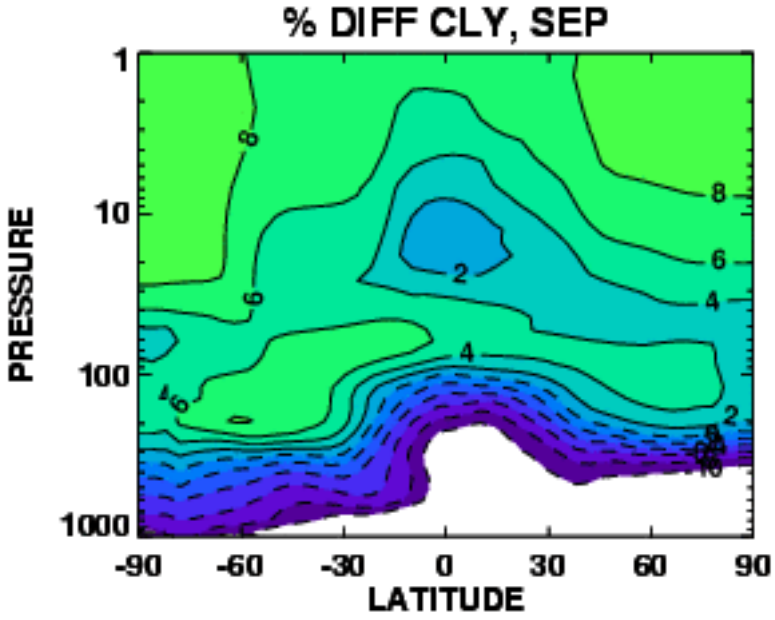

COMBO NOY, SEP
LCOMBO NOY, SEP
DIFF NOY, SEP
% DIFF NOY, SEP
PRESSURE
LATITUDE
1
10
100
1000
-90
-60
-30
0
30
60
90

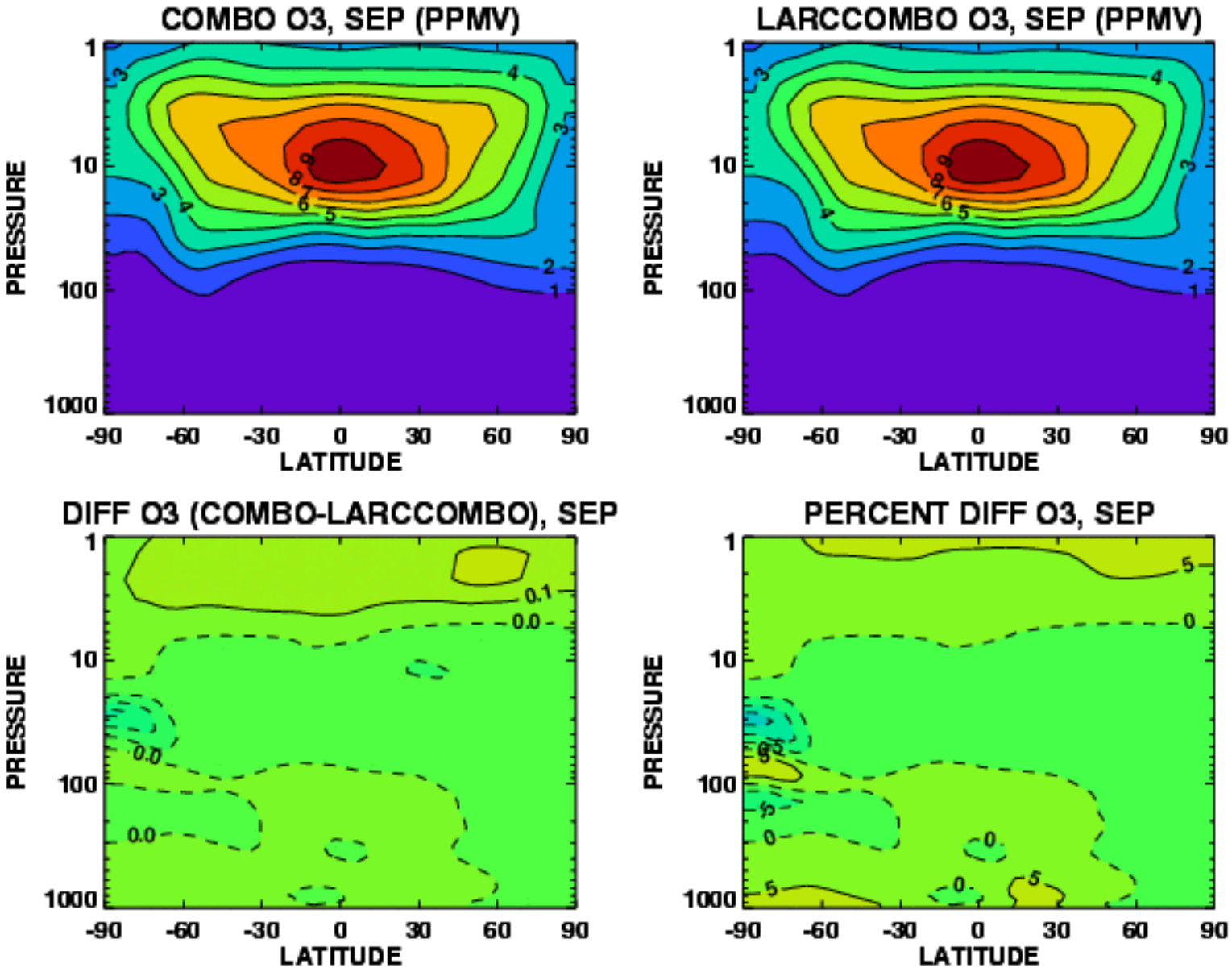

COMBO DEHYD, SEP (PPMV)
PRESSURE
1
10
100
1000
-90
-60
-30
0
30
60
90
LATITUDE
0.2
0.6
0.8
0.4
0.0
LCOMBO DEHYD, SEP (PPMV)
PRESSURE
1
10
100
1000
-90
-60
-30
0
30
60
90
LATITUDE
0.2
0.6
0.8
0.4
0.0

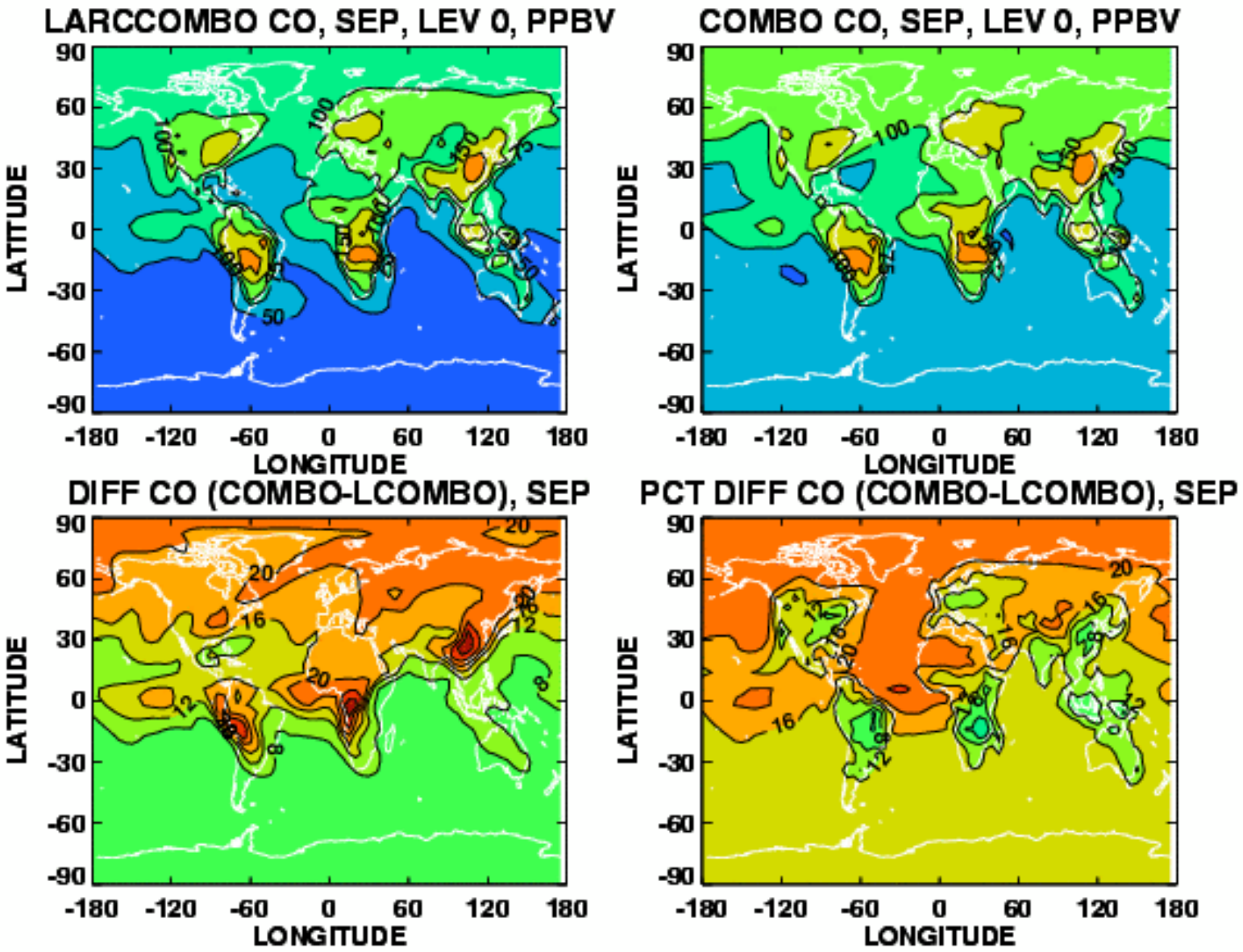

COMBO CLY, SEP (PPTV)
PRESSURE
LATITUDE
1
10
100
1000
-90
-60
-30
0
30
60
90
3250.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
100.00
50.00
10.00
5.00
1.00

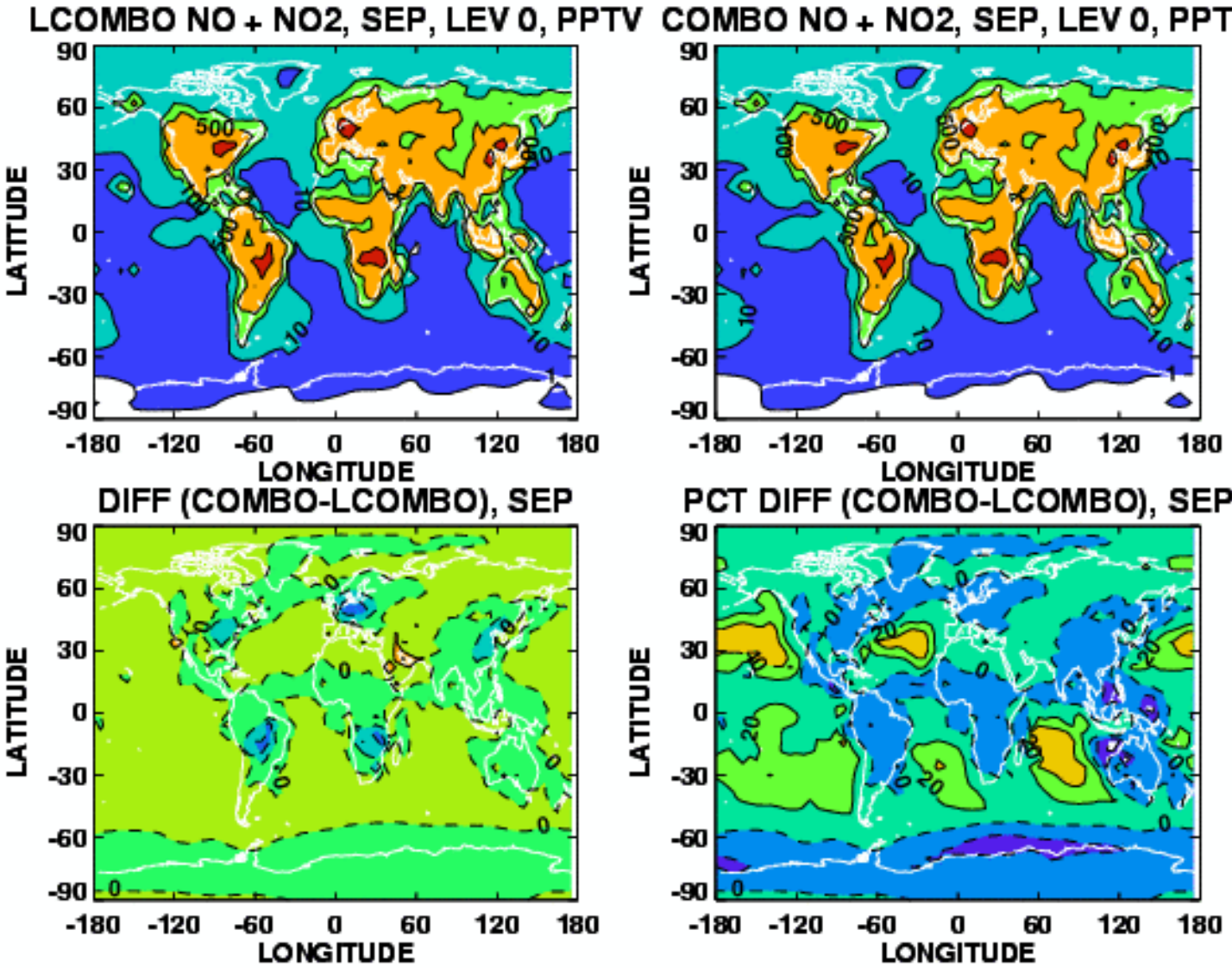

LCOMBO CLY, SEP (PPTV)
PRESSURE
LATITUDE
1
10
100
1000
-90
-60
-30
0
30
60
90
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
100.00
50.00
10.00
5.00
1.00

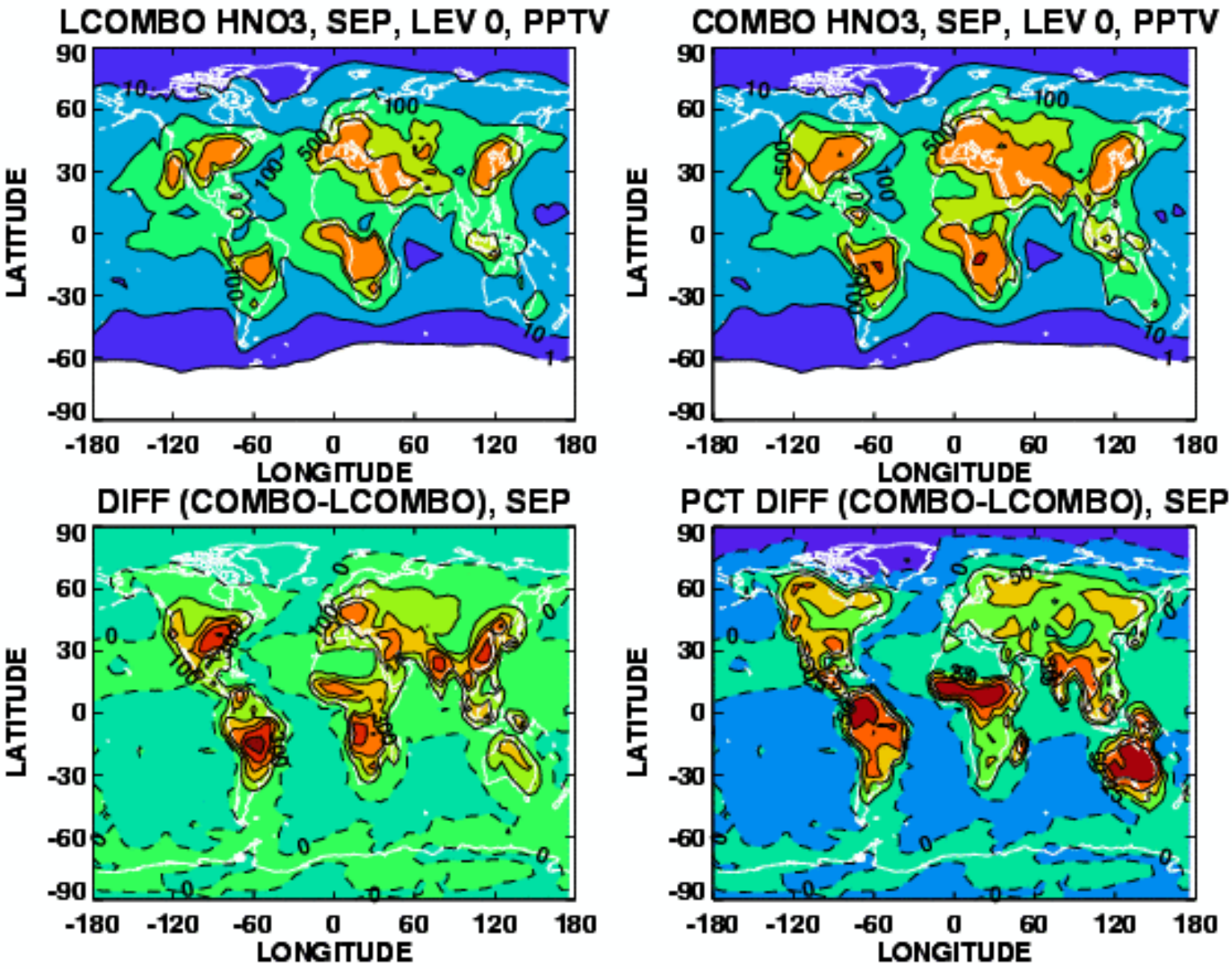

DIFF CLY, SEP (PPTV)
PRESSURE
LATITUDE
1
10
100
1000
-90
-60
-30
0
30
60
90
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
40

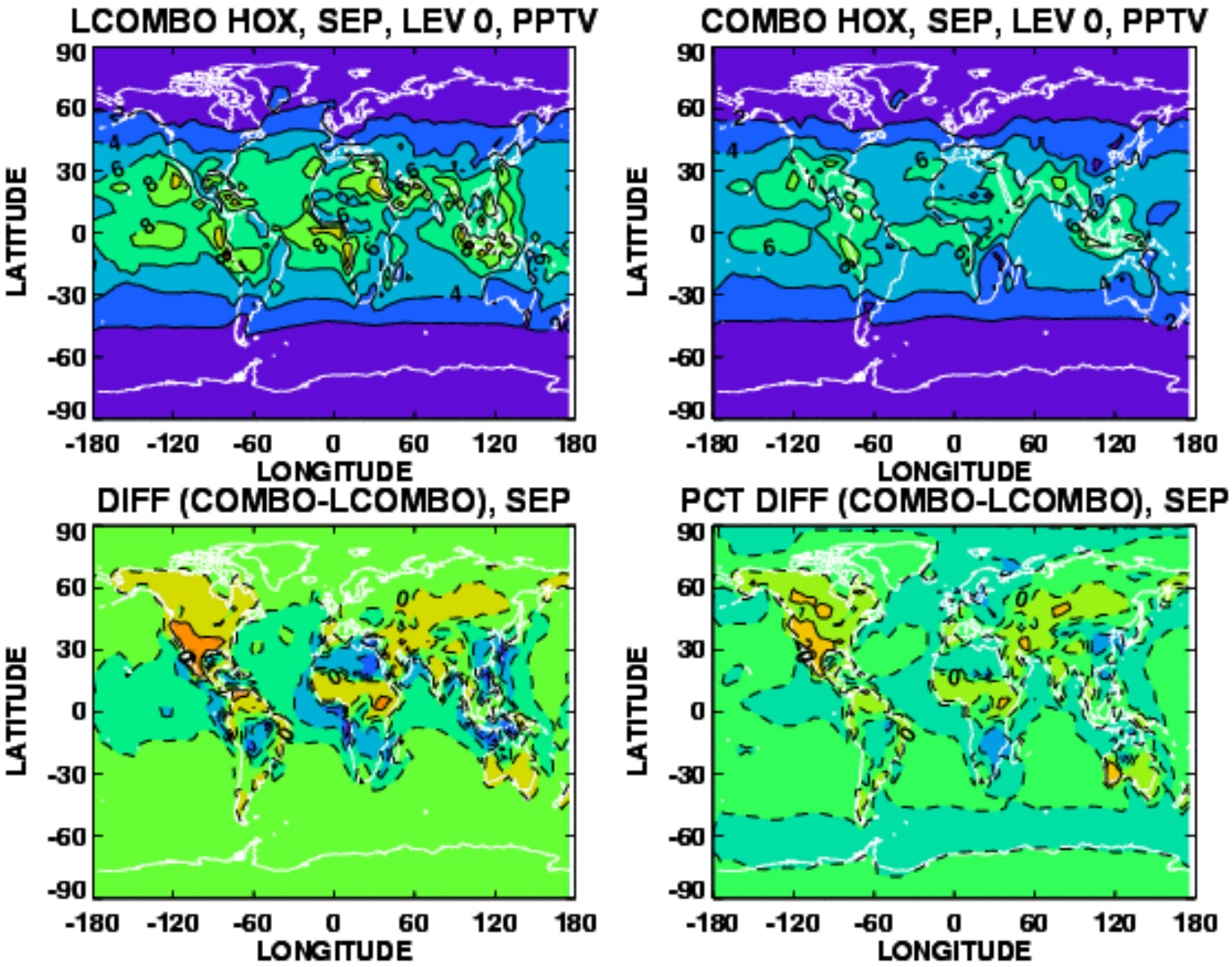

% DIFF CLY, SEP
PRESSURE
LATITUDE
1
10
100
1000
-90
-60
-30
0
30
60
90
8
6
4
2


COMBO O3, SEP (PPMV)
LARCCOMBO O3, SEP (PPMV)
DIFF O3 (COMBO-LARCCOMBO), SEP
PERCENT DIFF O3, SEP
PRESSURE
LATITUDE
1
10
100
1000
-90
-60
-30
0
30
60
90


LARCCOMBO CO, SEP, LEV 0, PPBV
COMBO CO, SEP, LEV 0, PPBV
DIFF CO (COMBO-LCOMBO), SEP
PCT DIFF CO (COMBO-LCOMBO), SEP
LATITUDE
LONGITUDE
90
60
30
0
-30
-60
-90
-180
-120
-60
0
60
120
180


LCOMBO NO + NO2, SEP, LEV 0, PPTV
COMBO NO + NO2, SEP, LEV 0, PPTV
DIFF (COMBO-LCOMBO), SEP
PCT DIFF (COMBO-LCOMBO), SEP
LATITUDE
LONGITUDE
90
60
30
0
-30
-60
-90
-180
-120
-60
0
60
120
180


LCOMBO HNO3, SEP, LEV 0, PPTV
COMBO HNO3, SEP, LEV 0, PPTV
DIFF (COMBO-LCOMBO), SEP
PCT DIFF (COMBO-LCOMBO), SEP
LATITUDE
LONGITUDE
90
60
30
0
-30
-60
-90
-180
-120
-60
0
60
120
180


LCOMBO HOX, SEP, LEV 0, PPTV
COMBO HOX, SEP, LEV 0, PPTV
DIFF (COMBO-LCOMBO), SEP
PCT DIFF (COMBO-LCOMBO), SEP
LATITUDE
LONGITUDE
90
60
30
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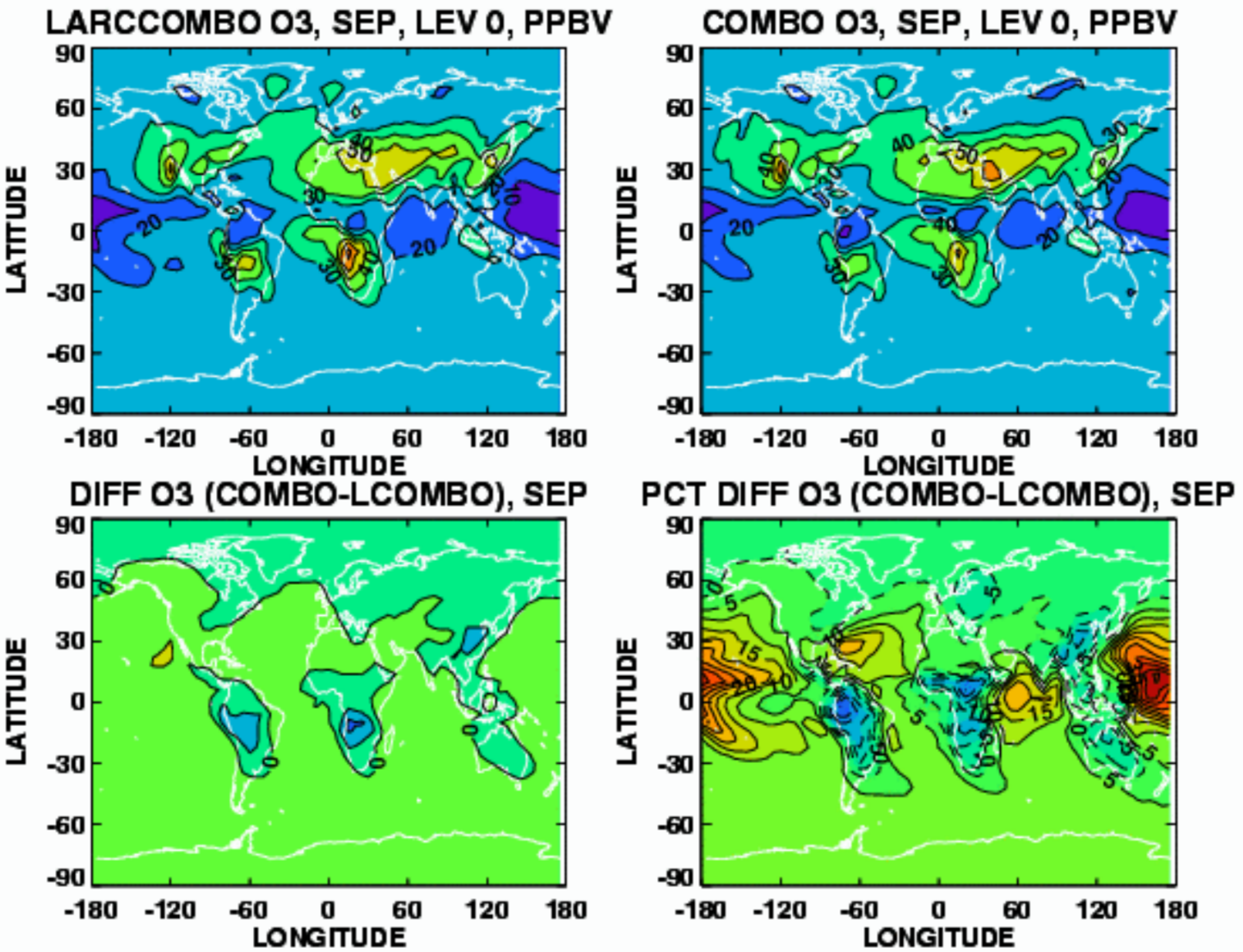
-60
-90
-180
-120
-60
0
60
120
180


LARCCOMBO O3, SEP, LEV 0, PPBV
COMBO O3, SEP, LEV 0, PPBV
DIFF O3 (COMBO-LCOMBO), SEP
PCT DIFF O3 (COMBO-LCOMBO), SEP
LATITUDE
LONGITUDE
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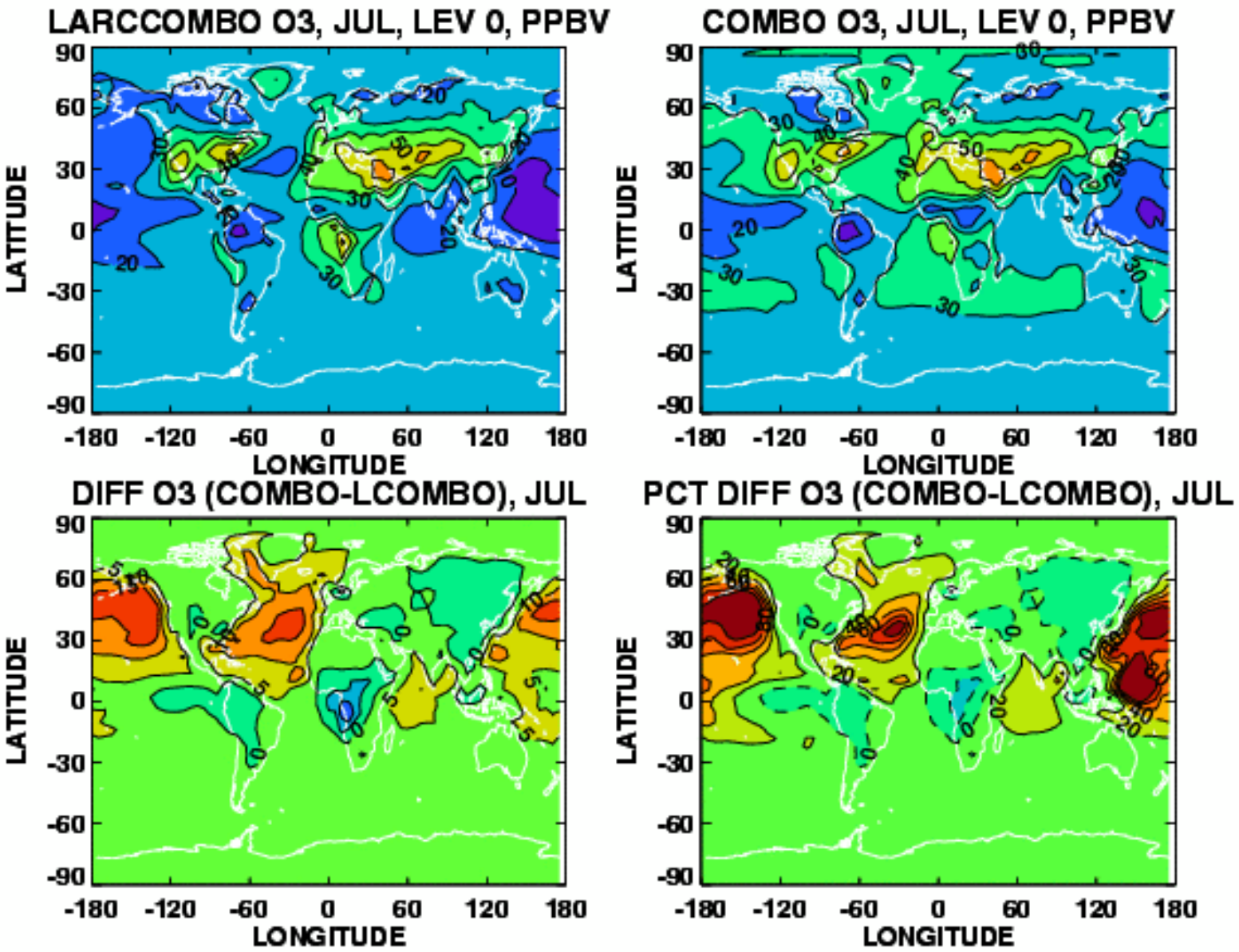
60
30
0
-30
-60
-90
-180
-120
-60
0
60
120
180


LARCCOMBO O3, JUL, LEV 0, PPBV
COMBO O3, JUL, LEV 0, PPBV
DIFF O3 (COMBO-LCOMBO), JUL
PCT DIFF O3 (COMBO-LCOMBO), JUL
LATITUDE
LONGITUDE
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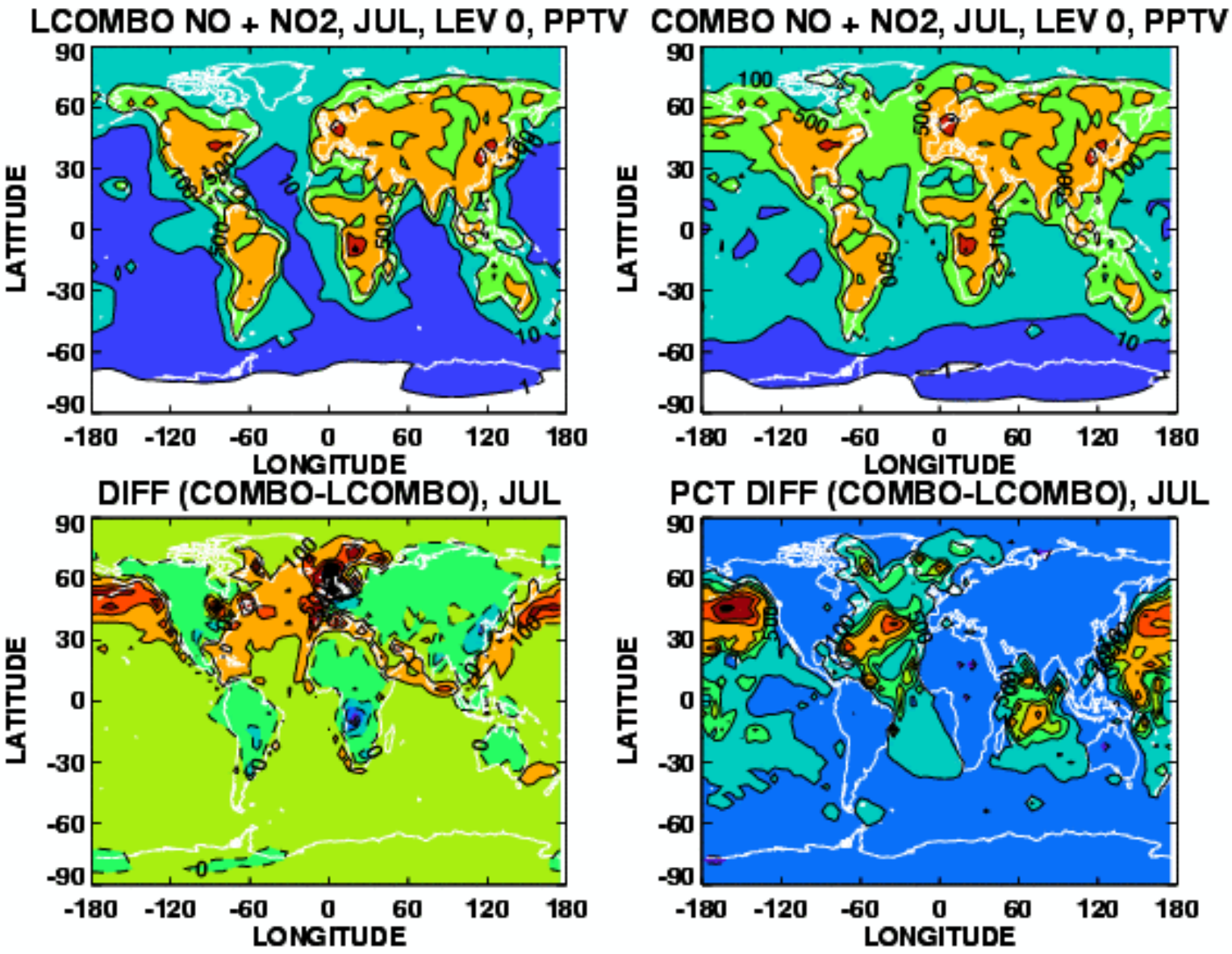
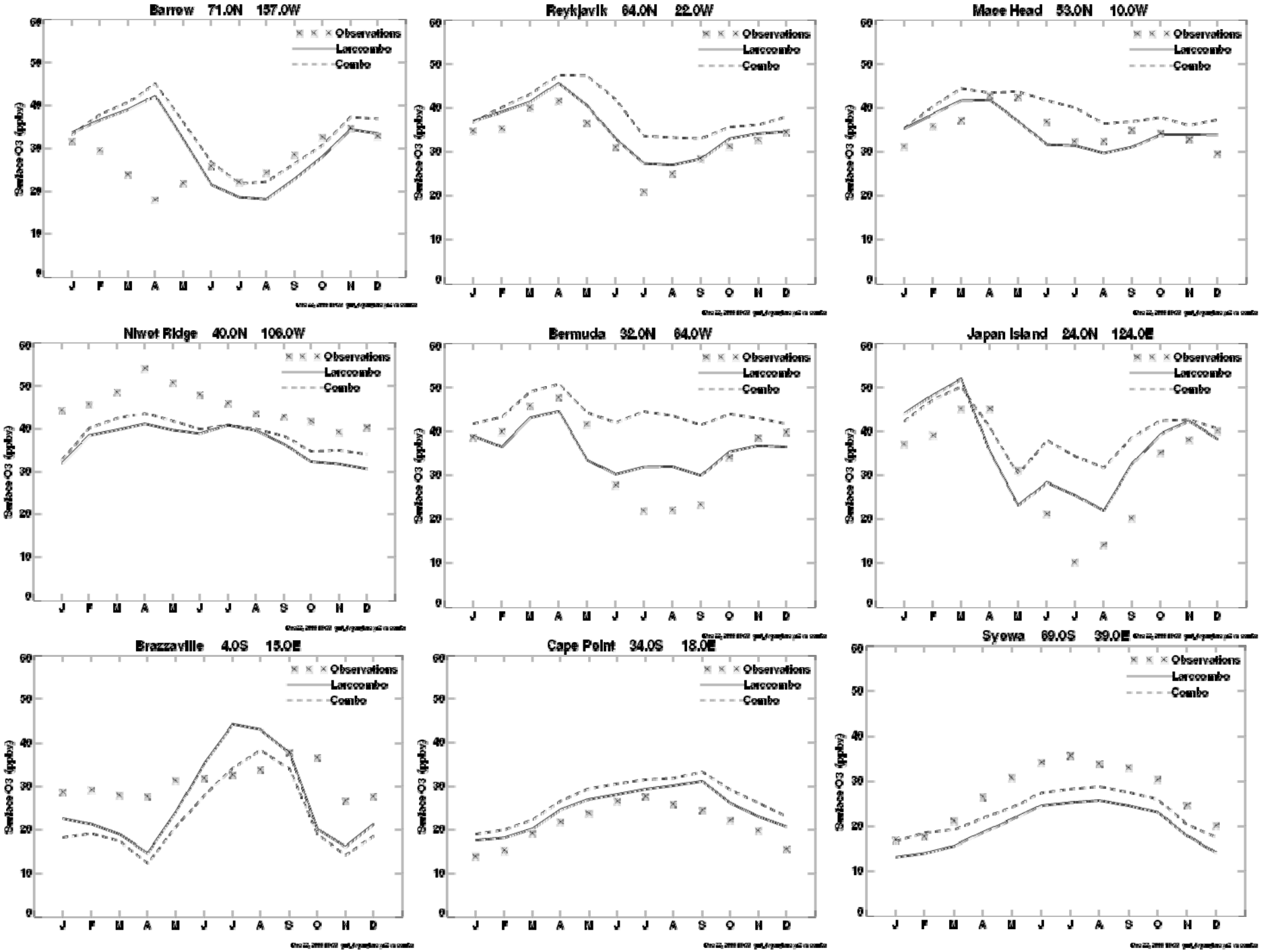
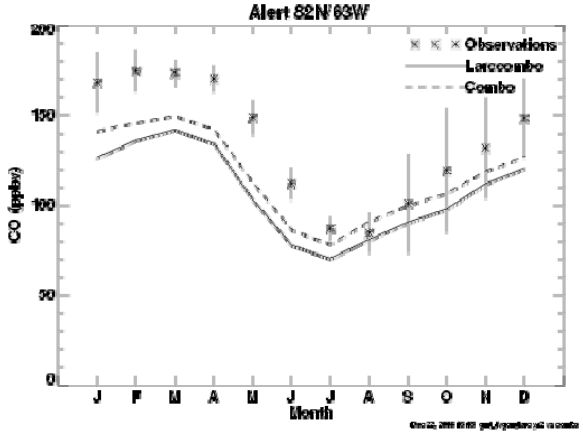
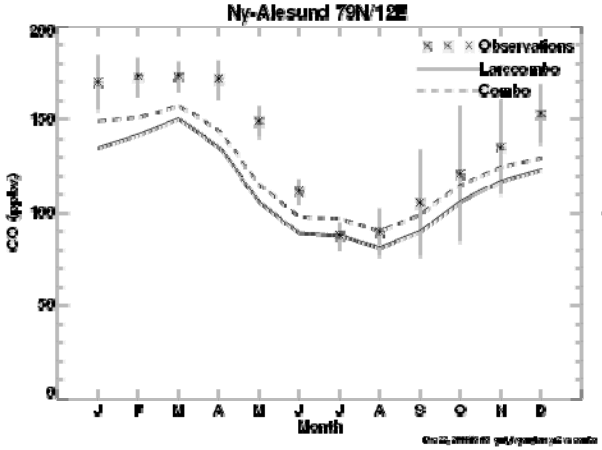
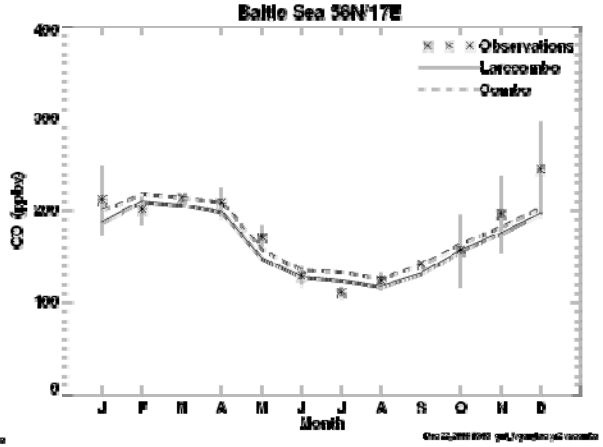
-30
-60
-90
-180
-120
-60
0
60
120
180

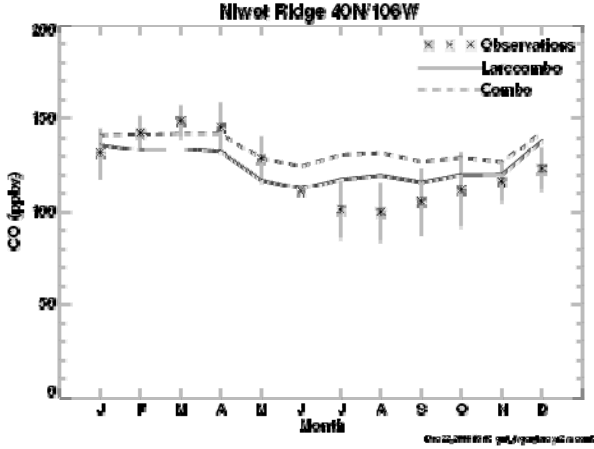

LCOMBO NO + NO2, JUL, LEV 0, PPTV
COMBO NO + NO2, JUL, LEV 0, PPTV
DIFF (COMBO-LCOMBO), JUL
PCT DIFF (COMBO-LCOMBO), JUL
LATITUDE
LONGITUDE
90
60
30
0
-30
-60
-90
-180
-120
-60
0
60
120
180

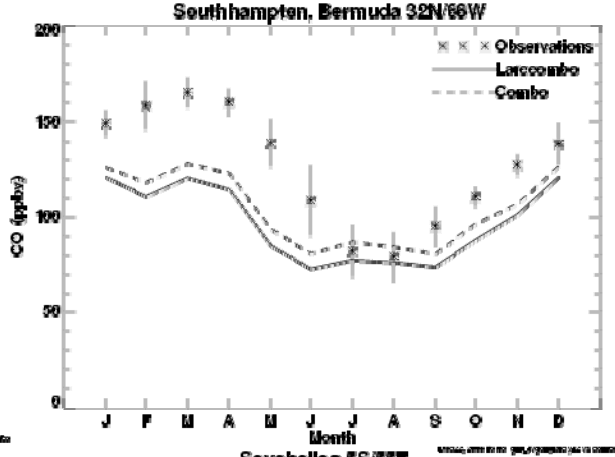

Barrow 71.0N 157.0W
Reykjavik 64.0N 22.0W
Mace Head 53.0N 10.0W
Niwot Ridge 40.0N 106.0W
Bermuda 32.0N 64.0W
Japan Island 24.0N 124.0E
Brazzaville 4.0S 15.0E
Cape Point 34.0S 18.0E
Syowa 69.0S 39.0E
Observations
Larcombo
Combo
Surface O3 (ppbv)
J F M A M J J A S O N D

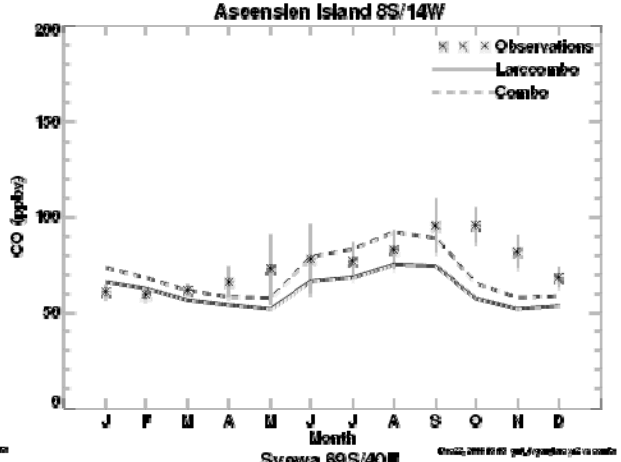

Alert 82N/63W
Observations
Larrcombo
Combo
CO (ppbv)
Month
J F M A M J J A S O N D

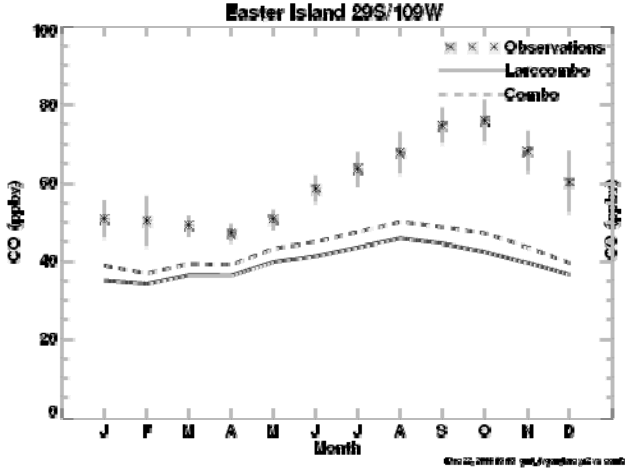

Ny-Alesund 79N/12E
Observations
Larrcombo
Combo
CO (ppbv)
Month
J F M A M J J A S O N D

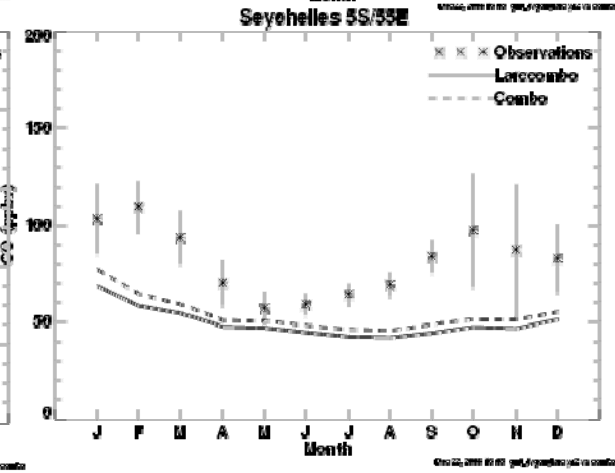

Baltic Sea 56N/17E
Observations
Larrcombo
Combo
CO (ppbv)
Month
J F M A M J J A S O N D

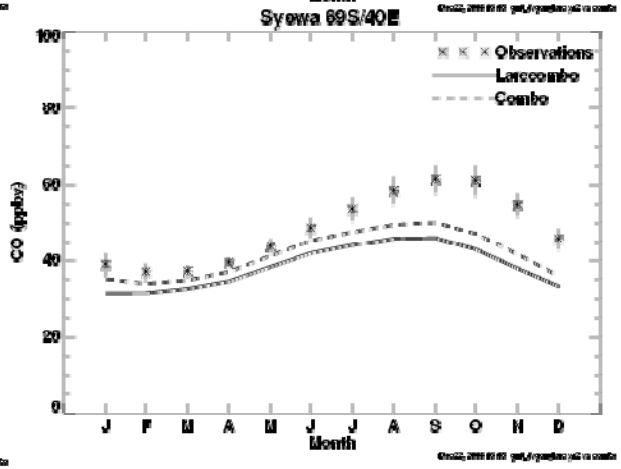

Niwot Ridge 40N/106W
Observations
Larrcombo
Combo
CO (ppbv)
Month
J F M A M J J A S O N D


Southhampton, Bermuda 32N/66W
Observations
Larrcombo
Combo
CO (ppbv)
Month
J F M A M J J A S O N D


Ascension Island 8S/14W
Observations
Larrcombo
Combo
CO (ppbv)
Month
J F M A M J J A S O N D


Easter Island 29S/109W
Observations
Larrcombo
Combo
CO (ppbv)
Month
J F M A M J J A S O N D


Seychelles 5S/55E
Observations
Larrcombo
Combo
CO (ppbv)
Month
J F M A M J J A S O N D


Syowa 69S/40E
Observations
Larrcombo
Combo
CO (ppbv)
Month
J F M A M J J A S O N D

Conclusions

- GMI Larccombo mechanism generally compares well with standard Combo mechanism.
- Some differences may be trivial (namelist file differences, reaction rate differences, etc.)
- Other differences are possibly mechanistic (e.g., compo species decompose directly to HNO3, Larccombo species decompose to organic nitrate, then to HNO3).
    - Combo surface O3 > Larccombo, remote regions
      < Larccombo, continental.
- Ship track NO substantially increases NOx and O3 concentrations along shipping lanes.
- Larccombo O3 without shipping NOx appears to agree better with O3 obs at remote locations.
    - Is effect of shipping emissions on NOx and O3 overestimated due to instantaneous mixing of emissions to model resolution?
- CO in both simulations somewhat low at surface; Combo tends to be better than Larccombo.